

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-018419

(43)Date of publication of application : 19.01.1996

(51)Int.Cl. H03K 17/16
H02M 1/08
H02M 3/155

(21)Application number : 06-146672 (71)Applicant : MURATA MFG CO LTD

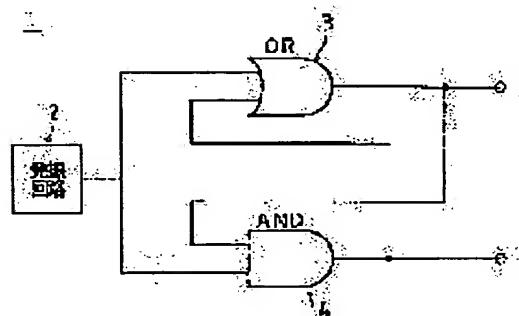
(22)Date of filing : 28.06.1994 (72)Inventor : MORISHIMA YASUYUKI
SANO NAOTO

(54) SWITCHING ELEMENT DRIVING CIRCUIT

(57)Abstract:

PURPOSE: To provide a switching element driving circuit for surely preventing a state in which two switching elements are simultaneously turned on.

CONSTITUTION: This switching element driving circuit 1 is provided with an oscillation circuit 2 for generating width-controlled control signals, an OR circuit 3 for outputting first driving signals for driving one of the switching elements and an AND circuit 4 for outputting second driving signals for driving the other switching element. The first driving signals of the OR circuit 3 are generated by ORing the control signals of the oscillation circuit 2 and the second driving signals of the AND circuit 4 and the second driving signals of the AND circuit 4 are generated by ANDing the control signals of the oscillation circuit 2 and the first driving signals of the OR circuit 3.



LEGAL STATUS

[Date of request for examination] 22.06.1999

[Date of sending the examiner's decision of rejection] 03.04.2001

[Kind of final disposal of application other than
the examiner's decision of rejection or
application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's
decision of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

(19)日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平8-18419

(43)公開日 平成8年(1996)1月19日

(51)Int.Cl. H03K 17/16 H02M 1/08 3/155	識別記号 L 9184-5K A H S	序内整理番号 P 1	技術表示箇所
---	----------------------------------	---------------	--------

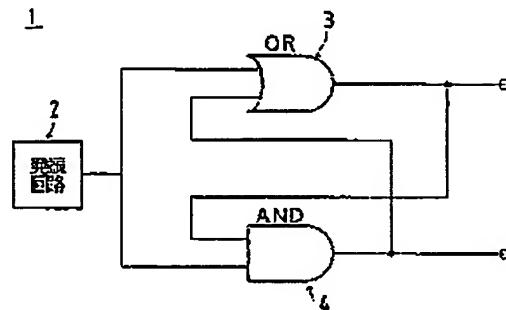
審査請求 未請求 請求項の数3 OL (全5頁)

(21)出願番号 特願平6-148672	(71)出願人 株式会社村田製作所 京都府長岡京市天神二丁目26番10号
(22)出願日 平成6年(1994)6月28日	(72)発明者 森島 翔之 京都府長岡京市天神二丁目26番10号 株式 会社村田製作所内
	(72)発明者 佐野 直人 京都府長岡京市天神二丁目26番10号 株式 会社村田製作所内

(54)【発明の名称】スイッチング素子駆動回路

(57)【要約】

【目的】2つのスイッチング素子が同時にオンする状態を確実に防ぐスイッチング素子駆動回路を提供する。
 【構成】このスイッチング素子駆動1は、幅制御された制御信号を発生する発振回路2と、スイッチング素子の一方を駆動する第1の駆動信号を出力する論理回路3と、スイッチング素子の他方を駆動する第2の駆動信号を出力する論理回路4と、を備え、論理回路3の第1の駆動信号は発振回路2の制御信号と論理回路4の第2の駆動信号とを論理和演算して生成し、論理回路4の第2の駆動信号は発振回路2の制御信号と論理回路3の第1の駆動信号とを論理積演算して生成することを特徴とする。



(2)

特開平8-18419

1

【特許請求の範囲】

【請求項1】2つのスイッチング素子を交互にスイッチングする同期式のスイッチング素子駆動回路において、幅制御された制御信号を発生する発振回路と、前記スイッチング素子の一方を駆動する第1の駆動信号を出力する論理回路と、前記スイッチング素子の他方を駆動する第2の駆動信号を出力する論理回路と、を備え、前記論理回路の第1の駆動信号は前記発振回路の制御信号と前記論理回路の第2の駆動信号とを論理和演算して生成し、前記論理回路の第2の駆動信号は前記発振回路の制御信号と前記論理回路の第1の駆動信号とを論理積演算して生成することにより、2つのスイッチング素子が同時にオンする状態を防ぐことを特徴とするスイッチング素子駆動回路。

【請求項2】前記論理回路と前記論理回路間に遅延回路を設けたことにより、前記スイッチング素子がスイッチするタイミングを調整したことを特徴とする請求項1記載のスイッチング素子駆動回路。

【請求項3】DC-DCコンバータのスイッチング素子を使用したことを特徴とする請求項1及び請求項2記載のスイッチング素子駆動回路。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、スイッチング素子駆動回路に関し、例えば、DC-DCコンバータに用いられるスイッチング素子駆動回路に関するもの。

【0002】

【従来の技術】直流電源を入力とし、安定化した直流電圧を出力する降圧チャッパ型のDC-DCコンバータの基本回路を図4に示す。図4において、11はDC-DCコンバータ、12は直流入力電源、13はMOS形のPチャンネルFET、14は発振回路、D1は整流ダイオード、L1はインダクタンス、C1はコンデンサ、R1は負荷を示す。

【0003】DC-DCコンバータ11は、直流入力電源12の直流電圧を発振回路14の駆動信号を印加したPチャンネルFET13によって高周波交流電圧にいったん変換し、PチャンネルFET13のオン、オフ時間比を制御することにより電圧レベルを変えて、最終的に整流ダイオードD1、インダクタンスL1、コンデンサC1で構成された平滑回路を通じて、3.3V乃至5Vの直流電圧に変換する。

【0004】このようなDC-DCコンバータ11では、使用される機器の省電力化のために電力損失を小さくする必要があり、その改善策として図5に示すように、比較的電力損失の大きな整流ダイオードD1のかわりにNチャンネルFET15を使用する方法が提案されている。この場合、NチャンネルFET15のゲートを発振回路14に接続し、図6に示すように、NチャンネルFET15のドレイン-ソース間のパルスQ2をPチ

ヤンネルFET13のドレイン-ソース間のパルスQ1に同期させて、PチャンネルFET13とNチャンネルFET15が交互にスイッチングすることにより、NチャンネルFET15は整流器として働く。そして、NチャンネルFET15は、オン抵抗を低くすることが可能であるため、DC-DCコンバータ11の電力損失を大きく改善することができる。

【0005】

【発明が解決しようとする課題】しかしながら、実際にPチャンネルFET13及びNチャンネルFET15は、駆動信号を印加されてからスイッチングするまでに数10n秒程度の遅延があり、このバラツキによってPチャンネルFET13とNチャンネルFET15がうまく同期せずに、同時にオンすることで地絡モードになり、電力損失がかえって増加してしまうという恐れがあった。

【0006】それゆえ、本発明の主たる目的は、2つのスイッチング素子が同時にオンする状態を確実に防ぐスイッチング素子駆動回路を提供することである。

【0007】

【課題を解決するための手段】上記の目的を達成するために、本発明は、2つのスイッチング素子を交互にスイッチングする同期式のスイッチング素子駆動回路において、幅制御された制御信号を発生する発振回路と、前記スイッチング素子の一方を駆動する第1の駆動信号を出力する論理回路と、前記スイッチング素子の他方を駆動する第2の駆動信号を出力する論理回路と、を備え、前記論理回路の第1の駆動信号は前記発振回路の制御信号と前記論理回路の第2の駆動信号とを論理和演算して生成し、前記論理回路の第2の駆動信号は前記発振回路の制御信号と前記論理回路の第1の駆動信号とを論理積演算して生成することにより、2つのスイッチング素子が同時にオンする状態を防ぐことを特徴とする。

【0008】そして、前記論理回路と前記論理回路間に遅延回路を設けたことにより、前記スイッチング素子がスイッチするタイミングを調整したことを特徴とする。

【0009】また、DC-DCコンバータのスイッチング素子を使用したことを特徴とする。

【0010】

【作用】上記の構成によれば、論理回路と論理回路を組み合わせることにより、2つのスイッチング素子が同時にオンする状態を防ぐことができる。また、論理回路と前記論理回路間に遅延回路を設けたことにより、スイッチング素子がスイッチするタイミングを調整することができる。

【0011】

【実施例】以下、本発明のスイッチング素子駆動回路の一実施例を図面を用いて説明する。図1の回路図において、1は2つのスイッチング素子(図示せず)を交互に

(3)

特開平8-18419

3

スイッチングする同期式のスイッチング素子駆動回路、2は発振回路、3は論理和回路、4は論理積回路を示す。論理和回路3は一方の入力部が発振回路2と接続され、他方の入力部が論理積回路4の出力部と接続され、出力部が一方のスイッチング素子と接続される。論理積回路4は一方の入力部が発振回路2と接続され、他方の入力部が論理和回路3の出力部と接続され、出力部が他方のスイッチング素子と接続される。

【0012】このように構成されたスイッチング素子駆動回路1では、論理和回路3が発振回路2から発生される帽制御された制御信号Aと後述する論理積回路4の駆動信号Cを論理積演算することにより、駆動信号Bを出力して一方のスイッチング素子を駆動する。また、論理*

* 積回路4が発振回路2の制御信号Aと論理和回路3の駆動信号Bを論理積演算することにより、駆動信号Cを出力して他方のスイッチング素子を駆動する。このような論理回路の組み合わせによれば、発振回路2の制御信号A、論理和回路3の駆動信号B、及び論理積回路4の駆動信号Cは、表1の真理値表に示すように、制御信号Aが1のときは駆動信号B及び駆動信号Cはともに1となり、制御信号Aが0のときは駆動信号B及び駆動信号Cはともに0となり、論理的には2つのスイッチング素子を完全に同期させることができる。

【0013】

【表1】

A	B	C	$B = A + C$	$C = A \times B$	$E - B$
0	0	0	0	0	0
0	0	1	1	0	1
0	1	0	1	0	x
0	1	1	1	0	x
1	0	0	1	0	x
1	0	1	1	0	x
1	1	0	1	1	x
1	1	1	1	1	0

【0014】次に、図5に示したDC-DCコンバータ11の発信回路14に変えて、スイッチング素子駆動回路1の論理和回路3の出力部とDC-DCコンバータ11のPチャンネルFET13のゲートを接続し、スイッチング素子駆動回路1の論理積回路4の出力部とDC-DCコンバータ11のNチャンネルFET15のゲートを接続した場合の実際のスイッチ動作について説明する。

【0015】図5に示したDC-DCコンバータ11は、PチャンネルFET13とNチャンネルFET15を同期させ、PチャンネルFET13とNチャンネルFET15が交互にスイッチすることにより、電力損失の小さいDC-DCコンバータとして働く。しかしながら、PチャンネルFET13とNチャンネルFET15がうまく同期せずに同時にオンしてしまうと、かえって電力損失が増加することから、PチャンネルFET13とNチャンネルFET15が同時にオンする状態を確実に防ぐことが課題となっている。

【0016】図2のタイムチャート図には、スイッチング素子駆動回路1の発振回路2の制御信号A、論理和回路3の駆動信号B、及び論理積回路4の駆動信号C、並びに、DC-DCコンバータ11のPチャンネルFET13のドレイン-ソース間のパルスQ1、及びNチャン

ネルFET15のドレイン-ソース間のパルスQ2の各波形が示されている。

【0017】まず、 $A = B = C = 0$ の状態から、 t_1 時点で、 $A = 1$ 、 $B = C = 0$ の状態となると、実際の半導体論理回路は入力信号に対して出力信号が数10n秒程度遅延することから、 t_2 時点で $B = A + C = 1$ となる。そして、 t_3 時点で、 $A = B = 1$ 、 $C = 0$ の状態となると、 t_4 時点で $C = A \times B = 1$ となる。

【0018】これにより、PチャンネルFET13のパルスQ1は、 t_1 時点で駆動信号B = 1が印加されてスイッチするが、駆動信号を印加されてからスイッチするまでにも数十ナノ秒程度の遅延があることから、 t_5 時点でオフからオフにスイッチする。そして、NチャンネルFET15のパルスQ2も、 t_3 時点で駆動信号C = 1が印加されることにより、 t_6 時点でオフからオンにスイッチする。

【0019】次に、スイッチング素子駆動回路1は、 $A = B = C = 1$ の状態から、 t_7 時点で、 $A = 0$ 、 $B = C = 1$ の状態となると、 t_8 時点で $C = A \times B = 0$ となる。そして、 t_9 時点で、 $A = C = 0$ 、 $B = 1$ の状態となり、 t_{10} 時点で $B = A + C = 0$ となる。

【0020】これにより、NチャンネルFET15のパルスQ2は、 t_7 時点で駆動信号C = 0が印加されるこ

(4)

特開平8-18419

5

とにより、 t_1 時点でオンからオフにスイッチする。そして、PチャンネルFET13のパルスQ1も、 t_1 時点で駆動信号B=0が印加されることにより、 t_1 時点でオフからオンにスイッチする。

〔0021〕この図2に示したPチャンネルFET13及びNチャンネルFET15のスイッチ動作からわかるように、実際には $t_1 - t$ 、時点間で $B = 1$ 、 $C = 0$ になり、 $t_1 - t$ 、時点間で $B = 1$ 、 $C = 0$ になるものの、それによって、PチャンネルFET13及びNチャンネルFET15は $t_1 - t$ 、時点間及び $t_1 - t_2$ 、時点間で同時にオフするだけで問題ではなく、PチャンネルFET13及びNチャンネルFET15が同時にオンする状態になることはない。

〔0022〕しかし、PチャンネルFET13及びNチャンネルFET15の駆動信号を印加されてからスイッチングするまでのスイッチングスピードが異なることにより、 $t_1 - t_2$ 時点間及び $t_3 - t_4$ 時点間が長くなる場合、或いは $t_5 - t_6$ 時点間及び $t_7 - t_8$ 時点間が短くなる場合は、PチャンネルFET13及びNチャンネルFET15が同時にオンする状態になる。そこで、このような場合には、図3に示すように、論理回路3の他方の入力部と論理回路4の出力部の間、及び論理回路4の他方の入力部と論理回路3の出力部の間に遅延回路5を設けることで、PチャンネルFET13及びNチャンネルFET15の駆動信号を印加されてからスイッチングするまでの遅延時間のバラツキを調整することができる。

〔0023〕また、このスイッチング素子駆動回路】は回路構成が簡単なことから安価で製造でき、低コストで確実なスイッチング素子の同期スイッチングが可能な高効率のDC-DCコンバータを実現できる。なお、上述の実施例では、MOS形FETを使用して説明したが、

*接合形FETなど、他のどのようなスイッチング素子でもよく、利用分野はDC-DCコンバータに限らない。

100241

【発明の効果】以上説明したように、本発明にかかるスイッチング素子駆動回路によれば、論理回路の組み合せにより、2つのFETが同時にオンする状態を防ぐことができ、遅延回路を加えたことで、前記スイッチング素子がスイッチするタイミングを調整することができる。また、回路構成が簡単なことから安価で製造でき、低コストで確実なスイッチング素子の同期スイッチングが可能となる。さらに、当該スイッチング素子駆動回路をDC-DCコンバータに用いることにより、DC-DCコンバータの電力損失を小さくする効果がある。

「画面の簡単な説明」

【図1】本発明の実施例におけるスイッチング素子駆動回路を示す回路図である。

【図2】図1のスイッチング素子駆動回路の各部波形を示したタイムチャート図である。

【図3】図1のスイッチング素子駆動回路に遅延回路を
加えた状態を示す回路図である。

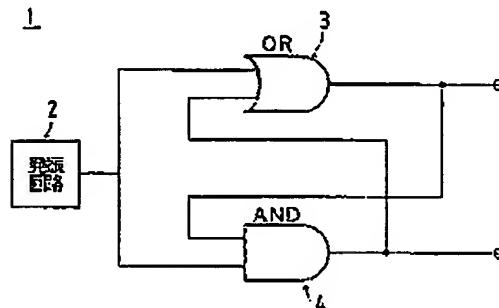
【図4】整流ダイオードを備えた従来のDC-DCコンバータを示す回路図である。

[図5] 図1のDC-DCコンバータの整流ダイオード

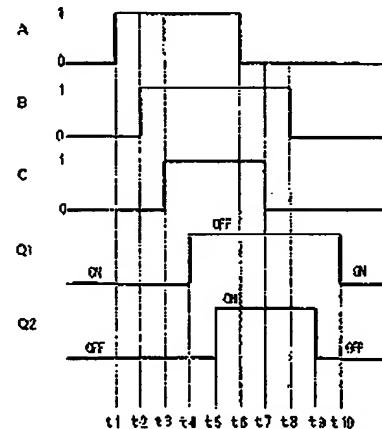
【符号の説明】

1 シンプル回路
 2 発振回路
 3 論理和回路
 4 論理積回路
 5 遅延回路

[1]



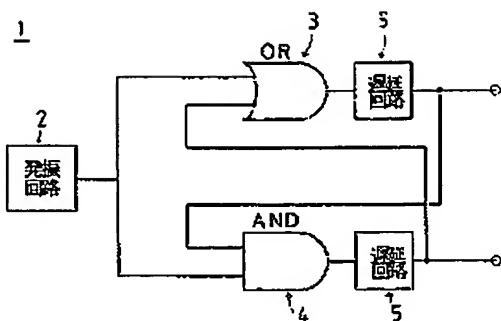
[図2]



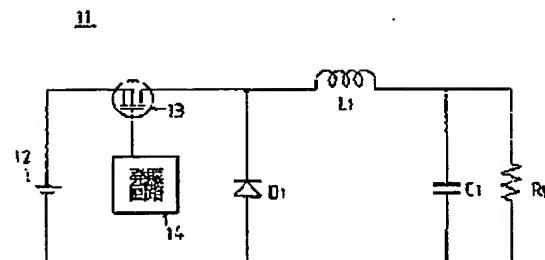
(5)

特開平8-18419

【図3】

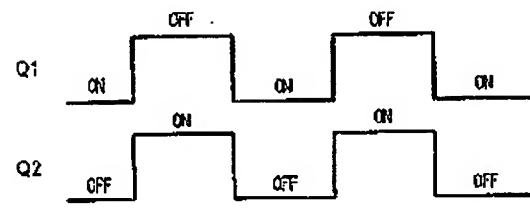
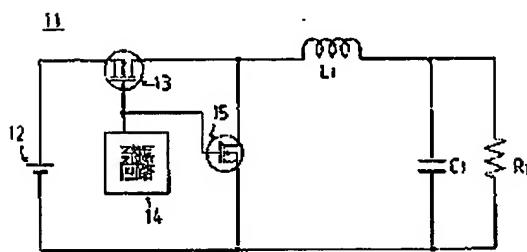


【図4】



【図6】

【図5】



Japanese Patent Application Publication No. 08-018419

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] In a switching element actuation circuit of synchronous system which switches two switching elements by turns An oscillator circuit which generates a control signal by which width-of-face control was carried out, and an OR circuit which outputs the 1st driving signal which drives one side of said switching element, An AND circuit which outputs the 2nd driving signal which drives another side of said switching element, The 1st driving signal of a preparation and said OR circuit carries out OR operation of a control signal of said oscillator circuit, and the 2nd driving signal of said AND circuit, and generates them. By carrying out the AND operation of a control signal of said oscillator circuit, and the 1st driving signal of said alternation gate, and generating them, the 2nd driving signal of said AND circuit is a switching element actuation circuit characterized by preventing the condition that two switching elements turn on simultaneously.

[Claim 2] A switching element actuation circuit according to claim 1 characterized by adjusting timing which said switching element switches by having prepared a delay circuit between said alternation gates and said AND circuits.

[Claim 3] Claim 1 characterized by using it for a switching element of a DC-DC converter, and a switching element actuation circuit according to claim 2.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the switching element actuation circuit used for a DC-DC converter, concerning a switching element actuation circuit.

[0002]

[Description of the Prior Art] DC power supply are considered as an input and the basic circuit of the DC-DC converter of the pressure-lowering chopper mold which outputs the stable direct current voltage is shown in drawing 4. drawing 4 -- setting -- 11 -- a DC-DC converter and 12 -- direct-current input power and 13 -- in P channel FET of an MOS form, and 14, an inductance and C1 show a capacitor and, as for an oscillator circuit and D1, R1 shows a load, as for rectifier diode and L1.

[0003] DC-DC converter 11 once changes the direct current voltage of the direct-current input power 12 into RF alternating voltage by P channel FET13 which impressed the driving signal of an oscillator circuit 14, by controlling ON of P channel FET13, and an off time amount ratio, changes a voltage level and changes it into the direct current voltage of 3.3V thru/or 5V through the smoothing circuit which consisted of rectifier diode D1, an inductance L1, and a capacitor C1 eventually.

[0004] It is necessary to make power loss small for power-saving of the device used, and in such DC-DC converter 11, as shown in drawing 5 as the remedy, the method of using the N channel FET 15 instead of the rectifier diode D1 with comparatively big power loss is proposed. In this case, as it connects with an oscillator circuit 14 and the gate of the N channel FET 15 is shown in drawing 6, when the pulse Q2 between the drain-sources of the N channel FET 15 is synchronized with the pulse Q1 between the drain-sources of P channel FET13 and P channel FET13 and the N channel FET 15 switch by turns, the N channel FET 15 works as a rectifier. And since the N channel FET 15 can make on resistance low, the power loss of DC-DC converter 11 is greatly improvable.

[0005]

[Problem(s) to be Solved by the Invention] however -- before [after a driving signal is actually impressed to P channel FET13 and the N channel FET 15] switching -- several 10 -- there was delay of an about [n second], it became ground mode by turning on simultaneously, without P channel FET3 and the N channel FET 5 synchronizing well by this variation, and there was a possibility that power loss may increase on the contrary.

[0006] So, the main object of this invention is offering the switching element actuation circuit which prevents certainly the condition two switching elements' turning on simultaneously.

[0007]

[Means for Solving the Problem] In a switching element actuation circuit of synchronous system with which this invention switches two switching elements by turns in order to attain the above-mentioned object An oscillator circuit which generates a control signal by which width-of-face control was carried out, and an OR circuit which outputs the 1st driving signal which drives one side of said switching element, An AND circuit which outputs the 2nd driving signal which drives another side of said switching element, The 1st driving signal of a preparation and said OR circuit carries out OR operation of a control signal of said oscillator circuit, and the 2nd driving signal of said AND circuit, and generates them. It is characterized by the 2nd driving

signal of said AND circuit preventing the condition that two switching elements turn on simultaneously by carrying out the AND operation of a control signal of said oscillator circuit, and the 1st driving signal of said alternation gate, and generating them.

[0008] And it is characterized by adjusting timing which said switching element switches by having prepared a delay circuit between said alternation gates and said AND circuits.

[0009] Moreover, it is characterized by using it for a switching element of a DC-DC converter.

[0010]

[Function] According to the above-mentioned configuration, two switching elements can prevent the condition of turning on simultaneously, by combining an alternation gate and an AND circuit. Moreover, the timing which a switching element switches can be adjusted by having prepared the delay circuit between the alternation gate and said AND circuit.

[0011]

[Example] Hereafter, one example of the switching element actuation circuit of this invention is explained using a drawing. In the circuit diagram of drawing 1, in the switching element actuation circuit of the synchronous system with which 1 switches two switching elements (not shown) by turns, and 2, an oscillator circuit and 3 show an OR circuit and 4 shows an AND circuit. One input section is connected with an oscillator circuit 2, the input section of another side is connected with the output section of AND circuit 4, and, as for OR circuit 3, the output section is connected with one switching element. One input section is connected with an oscillator circuit 2, the input section of another side is connected with the output section of an alternation gate 3, and, as for AND circuit 4, the output section is connected with the switching element of another side.

[0012] Thus, in the constituted switching element actuation circuit 1, when OR circuit 3 carries out OR operation of the control signal A which is generated from an oscillator circuit 2 and by which width-of-face control was carried out, and the driving signal C of AND circuit 4 mentioned later, a driving signal B is outputted and one switching element is driven. Moreover, when AND circuit 4 carries out the AND operation of the control signal A of an oscillator circuit 2, and the driving signal B of OR circuit 3, a driving signal C is outputted and the switching element of another side is driven. According to the combination of such a logical circuit, the control signal A of an oscillator circuit 2, the driving signal B of OR circuit 3, and the driving signal C of AND circuit 4 As shown in the table of truth value of a table 1, when a control signal A is 0, both the driving signal B and the driving signal C are set to 0, when a control signal A is 1, both the driving signal B and the driving signal C are set to 1, and it becomes possible to synchronize two switching elements thoroughly logically.

[0013]

[A table 1]

[0014] Next, actual switching at the time of changing into the dispatch circuit 14 of DC-DC converter 11 shown in drawing 5, connecting the gate of P channel FET13 of DC-DC converter 11 with the output section of the alternation gate 3 of the switching element actuation circuit 1, and connecting the gate of the N channel FET 15 of DC-DC converter 11 with the output section of AND circuit 4 of the switching element actuation circuit 1 is explained.

[0015] DC-DC converter 11 shown in drawing 5 works as a small DC-DC converter of power loss, when P channel FET13 and the N channel FET 15 are synchronized and P channel FET13 and the N channel FET 15 switch by turns. However, after P channel FET13 and the N channel FET 15 turn on simultaneously, without synchronizing well, since power loss increases on the contrary, it has been a technical problem to prevent certainly the condition that P channel FET13

and the N channel FET 15 turn on simultaneously.

[0016] Each wave of the pulse Q1 between the drain-sources of P channel FET13 of DC-DC converter 11 and the pulse Q2 between the drain-sources of the N channel FET 15 is shown in timing diagram drawing of drawing 2 at the control signal A, the driving signal B of an alternation gate 3 and the driving signal C of AND circuit 4, and list of an oscillator circuit 2 of the switching element actuation circuit 1.

[0017] First, the condition of $A=B=C=0$ to t_1 When it will be in the condition of $A=1$ and $B=C=0$ at the event, a actual semiconductor logical circuit is t_2 since an output signal carries out several 10n second grade delay to an input signal. It is set to $B=A+C=1$ at the event. And t_2 It is t_3 when it will be in the condition of $A=B=1$ and $C=0$ at the event. It is set to $C=AxB=1$ at the event.

[0018] Thereby, the pulse Q1 of P channel FET13 is t_2 . t_4 since there is delay for about dozens of nanoseconds after a driving signal is impressed also before switching although a driving signal $B=1$ is impressed and being switched at the event It switches off from ON at the event. And the pulse Q2 of the N channel FET 15 is also t_3 . By impressing a driving signal $C=1$ at the event, it is t_5 . It switches to ON from OFF at the event.

[0019] Next, the switching element actuation circuit 1 is the condition of $A=B=C=1$ to t_6 . It is t_7 when it will be in the condition of $A=0$ and $B=C=1$ at the event. It is set to $C=AxB=0$ at the event. And t_7 At the event, it will be in the condition of $A=C=0$ and $B=1$, and is t_8 . It is set to $B=A+C=0$ at the event.

[0020] Thereby, the pulse Q2 of the N channel FET 15 is t_7 . By impressing a driving signal $C=0$ at the event, it is t_9 . It switches off from ON at the event. And the pulse Q1 of P channel FET13 is also t_8 . By impressing a driving signal $B=0$ at the event, it switches to ON from OFF at the t_{10} event.

[0021] So that switching of the P channel FET13 and the N channel FET 15 which were shown in this drawing 2 may show actual -- t_2-t_3 an event -- between -- it is -- $B=1$ and $C=0$ -- becoming -- t_6-t_7 an event -- between -- it is -- $B=1$ -- by it, although set to 1 and $C=0$ P channel FET13 and the N channel FET 15 -- t_4-t_5 an event -- between -- and -- t -- nine - t -- ten -- an event -- between -- it is -- simultaneous -- turning off -- only -- a problem -- there is nothing -- P -- a channel -- FET -- 13 -- and -- N -- a channel -- FET -- 15 -- simultaneous -- turning on -- a condition -- becoming -- things -- there is nothing .

[0022] However, when switching speed after the driving signal of P channel FET13 and the N channel FET 15 is impressed until it switches differs t_2-t_4 an event -- between and t_7-t_9 an event -- between -- long -- becoming -- a case -- or -- t -- 3 -- - - - t_5 an event -- between -- and -- t -- eight -- - - - t -- ten -- < -- / -- SUB -- > -- an event -- between -- short -- becoming -- a case -- P -- a channel -- FET -- 13 -- and -- N -- a channel -- FET -- 15 -- simultaneous -- turning on -- a So, in such a case, as shown in drawing 3 , the variation in a time delay after the driving signal of P channel FET13 and the N channel FET 15 is impressed until it switches can be adjusted by forming a delay circuit 5 between the input section of another side of OR circuit 3, and the output section of AND circuit 4, and between the input section of another side of AND circuit 4, and the output section of OR circuit 3.

[0023] Moreover, from circuitry being easy, this switching element actuation circuit 1 can be cheap, and can be manufactured, and the efficient DC-DC converter in which synchronous switching of a positive switching element is possible can be realized by low cost. In addition, in the above-mentioned example, although explained using the MOS FET, a switching element like other throats is sufficient as a junction type FET etc., and a field of the invention does not restrict

it to a DC-DC converter.

[0024]

[Effect of the Invention] As explained above, according to the switching element actuation circuit concerning this invention, with the combination of a logical circuit, the condition that two FET turns on simultaneously can be prevented and the timing which said switching element switches can be adjusted by having added the delay circuit. Moreover, from an easy thing, circuitry is cheap, and can manufacture, and synchronous switching of a positive switching element of it becomes possible by low cost. Furthermore, there is an effect which makes power loss of a DC-DC converter small by using the switching element actuation circuit concerned for a DC-DC converter.

TECHNICAL FIELD

[Industrial Application] This invention relates to the switching element actuation circuit used for a DC-DC converter, concerning a switching element actuation circuit.

PRIOR ART

[Description of the Prior Art] DC power supply are considered as an input and the basic circuit of the DC-DC converter of the pressure-lowering chopper mold which outputs the stable direct current voltage is shown in drawing 4. drawing 4 -- setting -- 11 -- a DC-DC converter and 12 -- direct-current input power and 13 -- in P channel FET of an MOS form, and 14, an inductance and C1 show a capacitor and, as for an oscillator circuit and D1, R1 shows a load, as for rectifier diode and L1.

[0003] DC-DC converter 11 once changes the direct current voltage of the direct-current input power 12 into RF alternating voltage by P channel FET13 which impressed the driving signal of an oscillator circuit 14, by controlling ON of P channel FET13, and an off time amount ratio, changes a voltage level and changes it into the direct current voltage of 3.3V thru/or 5V through the smoothing circuit which consisted of rectifier diode D1, an inductance L1, and a capacitor C1 eventually.

[0004] It is necessary to make power loss small for power-saving of the device used, and in such DC-DC converter 11, as shown in drawing 5 as the remedy, the method of using the N channel FET 15 instead of the rectifier diode D1 with comparatively big power loss is proposed. In this case, as it connects with an oscillator circuit 14 and the gate of the N channel FET 15 is shown in drawing 6, when the pulse Q2 between the drain-sources of the N channel FET 15 is synchronized with the pulse Q1 between the drain-sources of P channel FET13 and P channel FET13 and the N channel FET 15 switch by turns, the N channel FET 15 works as a rectifier. And since the N channel FET 15 can make on resistance low, the power loss of DC-DC converter 11 is greatly improvable.

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to the switching element actuation circuit concerning this invention, with the combination of a logical circuit, the condition that two FET turns on simultaneously can be prevented and the timing which said switching element switches can be adjusted by having added the delay circuit. Moreover, from an easy thing, circuitry is cheap, and can manufacture, and synchronous switching of a positive switching element of it becomes possible by low cost. Furthermore, there is an effect which makes power loss of a DC-DC converter small by using the switching element actuation circuit concerned for a DC-DC converter.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] however -- before [after a driving signal is actually impressed to P channel FET13 and the N channel FET 15] switching -- several 10 -- there was delay of an about [n second], it became ground mode by turning on simultaneously, without P channel FET3 and the N channel FET 5 synchronizing well by this variation, and there was a possibility that power loss may increase on the contrary.

[0006] So, the main object of this invention is offering the switching element actuation circuit which prevents certainly the condition two switching elements' turning on simultaneously.

MEANS

[Means for Solving the Problem] In a switching element actuation circuit of synchronous system with which this invention switches two switching elements by turns in order to attain the above-mentioned object An oscillator circuit which generates a control signal by which width-of-face control was carried out, and an OR circuit which outputs the 1st driving signal which drives one side of said switching element, An AND circuit which outputs the 2nd driving signal which drives another side of said switching element, The 1st driving signal of a preparation and said OR circuit carries out OR operation of a control signal of said oscillator circuit, and the 2nd driving signal of said AND circuit, and generates them. It is characterized by the 2nd driving signal of said AND circuit preventing the condition that two switching elements turn on simultaneously by carrying out the AND operation of a control signal of said oscillator circuit, and the 1st driving signal of said alternation gate, and generating them.

[0008] And it is characterized by adjusting timing which said switching element switches by having prepared a delay circuit between said alternation gates and said AND circuits.

[0009] Moreover, it is characterized by using it for a switching element of a DC-DC converter.

OPERATION

[Function] According to the above-mentioned configuration, two switching elements can prevent the condition of turning on simultaneously, by combining an alternation gate and an AND circuit. Moreover, the timing which a switching element switches can be adjusted by having prepared the delay circuit between the alternation gate and said AND circuit.

EXAMPLE

[Example] Hereafter, one example of the switching element actuation circuit of this invention is explained using a drawing. In the circuit diagram of drawing 1, in the switching element actuation circuit of the synchronous system with which 1 switches two switching elements (not shown) by turns, and 2, an oscillator circuit and 3 show an OR circuit and 4 shows an AND circuit. One input section is connected with an oscillator circuit 2, the input section of another side is connected with the output section of AND circuit 4, and, as for OR circuit 3, the output section is connected with one switching element. One input section is connected with an oscillator circuit 2, the input section of another side is connected with the output section of an alternation gate 3, and, as for AND circuit 4, the output section is connected with the switching element of another side.

[0012] Thus, in the constituted switching element actuation circuit 1, when OR circuit 3 carries out OR operation of the control signal A which is generated from an oscillator circuit 2 and by which width-of-face control was carried out, and the driving signal C of AND circuit 4 mentioned later, a driving signal B is outputted and one switching element is driven. Moreover, when AND circuit 4 carries out the AND operation of the control signal A of an oscillator circuit 2, and the driving signal B of OR circuit 3, a driving signal C is outputted and the switching element of another side is driven. According to the combination of such a logical circuit, the control signal A of an oscillator circuit 2, the driving signal B of OR circuit 3, and the driving signal C of AND circuit 4 As shown in the table of truth value of a table 1, when a control signal A is 0, both the driving signal B and the driving signal C are set to 0, when a control signal A is 1, both the driving signal B and the driving signal C are set to 1, and it becomes possible to synchronize two switching elements thoroughly logically.

[0013]

[A table 1]

[0014] Next, actual switching at the time of changing into the dispatch circuit 14 of DC-DC converter 11 shown in drawing 5, connecting the gate of P channel FET13 of DC-DC converter 11 with the output section of the alternation gate 3 of the switching element actuation circuit 1, and connecting the gate of the N channel FET 15 of DC-DC converter 11 with the output section of AND circuit 4 of the switching element actuation circuit 1 is explained.

[0015] DC-DC converter 11 shown in drawing 5 works as a small DC-DC converter of power loss, when P channel FET13 and the N channel FET 15 are synchronized and P channel FET13 and the N channel FET 15 switch by turns. However, after P channel FET13 and the N channel FET 15 turn on simultaneously, without synchronizing well, since power loss increases on the contrary, it has been a technical problem to prevent certainly the condition that P channel FET13 and the N channel FET 15 turn on simultaneously.

[0016] Each wave of the pulse Q1 between the drain-sources of P channel FET13 of DC-DC converter 11 and the pulse Q2 between the drain-sources of the N channel FET 15 is shown in timing diagram drawing of drawing 2 at the control signal A, the driving signal B of an alternation gate 3 and the driving signal C of AND circuit 4, and list of an oscillator circuit 2 of the switching element actuation circuit 1.

[0017] First, the condition of $A=B=C=0$ to t_1 When it will be in the condition of $A=1$ and $B=C=0$ at the event, a actual semiconductor logical circuit is t_2 since an output signal carries out several $10n$ second grade delay to an input signal. It is set to $B=A+C=1$ at the event. And t_2 It is

t3 when it will be in the condition of A=B=1 and C= 0 at the event. It is set to C=AxB=1 at the event.

[0018] Thereby, the pulse Q1 of P channel FET13 is t2. t4 since there is delay for about dozens of nanoseconds after a driving signal is impressed also before switching although a driving signal B= 1 is impressed and being switched at the event It switches off from ON at the event. And the pulse Q2 of the N channel FET 15 is also t3. By impressing a driving signal C= 1 at the event, it is t5. It switches to ON from OFF at the event.

[0019] Next, the switching element actuation circuit 1 is the condition of A=B=C=1 to t6. It is t7 when it will be in the condition of A= 0 and B=C=1 at the event. It is set to C=AxB=0 at the event. And t7 At the event, it will be in the condition of A=C=0 and B= 1, and is t8. It is set to B=A+C=0 at the event.

[0020] Thereby, the pulse Q2 of the N channel FET 15 is t7. By impressing a driving signal C= 0 at the event, it is t9. It switches off from ON at the event. And the pulse Q1 of P channel FET13 is also t8. By impressing a driving signal B= 0 at the event, it switches to ON from OFF at the t10 event.

[0021] So that switching of the P channel FET13 and the N channel FET 15 which were shown in this drawing 2 may show actual -- t2-t3 an event -- between -- it is -- B= 1 and C= 0 -- becoming -- t6-t7 an event -- between -- it is -- B= -- by it, although set to 1 and C= 0 P channel FET13 and the N channel FET 15 -- t4-t5 an event -- between -- and -- t -- nine - t -- ten -- an event -- between -- it is -- simultaneous -- turning off -- only -- a problem -- there is nothing -- P -- a channel -- FET -- 13 -- and -- N -- a channel -- FET -- 15 -- simultaneous -- turning on -- a condition -- becoming -- things -- there is nothing .

[0022] however, the thing which switching speed after the driving signal of P channel FET13 and the N channel FET 15 is impressed until it switches differs -- t2-t4 an event -- between and t7-t9 an event -- between -- long -- becoming -- a case -- or -- t -- 3 -- t5 an event -- between - - and -- t -- eight -- t -- ten -- an event -- between -- short -- becoming -- a case -- P -- a channel -- FET So, in such a case, as shown in drawing 3 , the variation in a time delay after the driving signal of P channel FET13 and the N channel FET 15 is impressed until it switches can be adjusted by forming a delay circuit 5 between the input section of another side of OR circuit 3, and the output section of AND circuit 4, and between the input section of another side of AND circuit 4, and the output section of OR circuit 3.

[0023] Moreover, from circuitry being easy, this switching element actuation circuit 1 can be cheap, and can be manufactured, and the efficient DC-DC converter in which synchronous switching of a positive switching element is possible can be realized by low cost. In addition, in the above-mentioned example, although explained using the MOS FET, a switching element like other throats is sufficient as a junction type FET etc., and a field of the invention does not restrict it to a DC-DC converter.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the circuit diagram showing the switching element actuation circuit in the example of this invention.

[Drawing 2] It is timing diagram drawing having shown each part wave of the switching element actuation circuit of drawing 1.

[Drawing 3] It is the circuit diagram showing the condition of having added the delay circuit to the switching element actuation circuit of drawing 1.

[Drawing 4] It is the circuit diagram showing the conventional DC-DC converter equipped with rectifier diode.

[Drawing 5] It is the circuit diagram showing the condition of having changed the rectifier diode of the DC-DC converter of drawing 1 into the MOS FET.

[Drawing 6] It is timing diagram drawing having shown each part wave of the DC-DC converter of drawing 5.

[Description of Notations]

1 Switching Element Actuation

2 Oscillator Circuit

3 OR Circuit

4 AND Circuit

5 Delay Circuit